

# Unit Rates and Conversions Summary

## KEY TERMS

- convert
- unit rate

LESSON  
**1**

## Many Ways to Measure

There are many situations in which you need to convert measurements to different units. To **convert** a measurement means to change it to an equivalent measurement in different units. When you convert a measurement to a different unit, the size of the object does not change; only the units and the number of those units change.

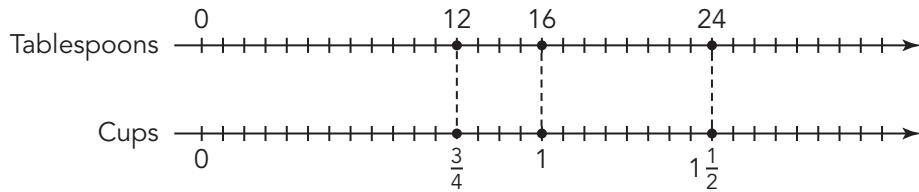
Conversions can be written using ratio language. They can also be written symbolically in terms of equality.

Ratio Language	Symbolically
For every inch, there are approximately 2.5 centimeters.	$1 \text{ in.} \approx 2.5 \text{ cm}$
For every meter, there is approximately 1 yard.	$1 \text{ m} \approx 1 \text{ yd}$
For every foot, there are approximately 30 centimeters.	$1 \text{ ft} \approx 30 \text{ cm}$
For every 12 inches, there is exactly 1 foot.	$12 \text{ in.} = 1 \text{ ft}$
For every 1 kilometer, there are exactly 1000 meters.	$1 \text{ km} = 1000 \text{ m}$

A conversion ratio is also called a conversion rate because two quantities that are measured in different units are being compared. For example, you can write the ratio of inches to feet in fractional form:  $\frac{12 \text{ in.}}{1 \text{ ft}}$ .

Because these measurement conversions are ratios, you can use ratio reasoning to convert between units, such as double number lines.

For example, the double number line shown represents the ratio of tablespoons to cups.



Using the double number line, you can determine that there are 12 tablespoons in  $\frac{3}{4}$  cup or that there are  $1\frac{1}{2}$  cups in 24 tablespoons.

Using a ratio table is another strategy for converting units. For example, this table represents the ratio of pounds to ounces.

<b>Pounds</b>	1	2	$\frac{1}{4}$	$1\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{8}$	$2\frac{1}{2}$
<b>Ounces</b>	16	32	4	20	8	6	40

+    =

You can add values in different columns to determine new equivalent rates.

Scaling up or down is a similar strategy for determining equivalent ratios that can more easily be used to convert from one unit of measurement to another.

For example, you can use scaling up to determine how many kilograms are in 2.5 pounds. Because you want to determine the number of kilograms for a specific number of pounds, use the conversion rate  $1 \text{ lb} = 0.45 \text{ kg}$  or  $\frac{1 \text{ lb}}{0.45 \text{ kg}}$ .

Scaling Up

$$\frac{1 \text{ lb}}{0.45 \text{ kg}} = \frac{2.5 \text{ lb}}{\text{? kg}} \longrightarrow \frac{1 \text{ lb}}{0.45 \text{ kg}} = \frac{2.5 \text{ lb}}{1.125 \text{ kg}}$$

$\times 2.5$   
 $\times 2.5$

You can also use unit analysis to determine the quantity in pounds that is equivalent to 4.5 kilograms. In unit analysis, you multiply by a form of 1 to rewrite the given measurement in a different unit.

Unit Analysis

$$4.5 \text{ kg} \left( \frac{2.2 \text{ lb}}{1 \text{ kg}} \right)$$

$$\frac{4.5 \text{ kg}}{1} \left( \frac{2.2 \text{ lb}}{1 \text{ kg}} \right) = 9.9 \text{ lb}$$

$$\frac{1 \text{ kg}}{2.2 \text{ lb}} = \frac{4.5 \text{ kg}}{9.9 \text{ lb}}$$

$$4.5 \text{ kg} = 9.9 \text{ lb}$$

LESSON  
**2**

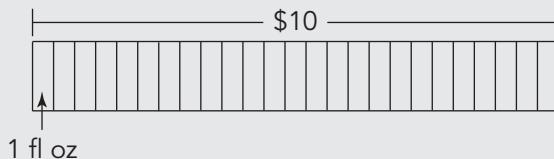
## What Is the Best Buy?

A rate is a ratio in which the two quantities being compared are measured in different units. A **unit rate** is a comparison of two measurements in which the denominator has a value of one unit.

One way to compare the values of products is to calculate the unit rate for each item.

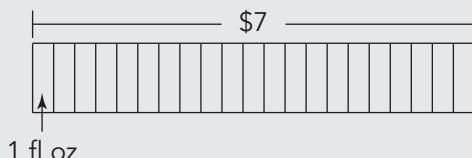
For example, a brand of laundry detergent comes in two different sizes: 26 fluid ounces for \$9.75 or 20.5 fluid ounces for \$7.25.

The larger bottle of detergent is about 25 fluid ounces for about \$10.



So, each fluid ounce costs about  $\frac{\$10}{25 \text{ fl oz}}$ , which is  $\frac{\$2}{5 \text{ fl oz}}$ , or  $\frac{\$0.40}{1 \text{ fl oz}}$ .

The smaller bottle of detergent is about 21 fluid ounces for about \$7.



So, each fluid ounce costs about  $\frac{\$7}{21 \text{ fl oz}}$ , which is  $\frac{\$1}{3 \text{ fl oz}}$ , or about  $\frac{\$0.33}{1 \text{ fl oz}}$ .

That means that you pay less for each fluid ounce of the smaller bottle of detergent, so it is the better buy.

Unit rates can be written with either quantity as the unit. In the example above, the unit rate was determined as the price per fluid ounce. It can also be written as the number of fluid ounces per dollar. For the larger bottle of detergent, you get about  $\frac{2.5 \text{ fl oz}}{\$1}$ , and for the smaller bottle of detergent you get about  $\frac{3 \text{ fl oz}}{\$1}$ .

Unit rates are helpful when solving problems about constant speeds.

For example, suppose Sara can ride 50 miles in 4 hours. At this rate, how far will she ride in 7 hours?

$$\frac{50 \text{ miles}}{4 \text{ hours}} = \frac{12.5 \text{ miles}}{1 \text{ hour}} \quad \frac{12.5 \text{ miles}}{1 \text{ hour}} = \frac{87.5 \text{ miles}}{7 \text{ hours}}$$

Scale down to determine the unit rate. Then scale up to determine the equivalent rate needed to solve the problem.

LESSON  
**3**

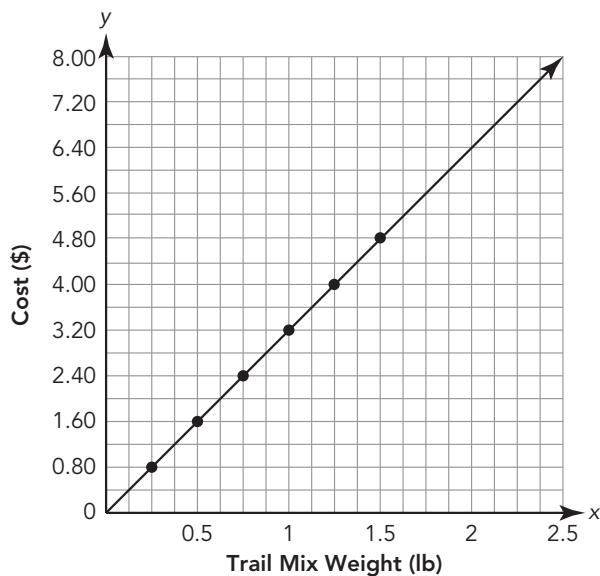
## Seeing Things Differently

You can represent rates and unit rates in a variety of different ways—in tables, on graphs, and in stories and other situations.

For example, the 6th grade chorus is selling bags of trail mix in various sizes to raise money for an upcoming trip. The group wants the ratio of cost-to-pounds to stay the same no matter the size of the bag. They decide to sell 1 lb bags for \$3.20.

The table shown displays the cost for various quantities of trail mix. These ratios are plotted on the graph and connected with a line.

Trail Mix Weight (lb)	Cost (\$)
0.25	0.80
0.5	1.60
0.75	2.40
1	3.20
1.25	4.00
1.5	4.80



The graph displays equivalent rates because each ordered pair that falls on the line is a multiple of  $(x, y)$  and is equivalent to the ratio  $\frac{y}{x}$ . You can use the graph to determine that the unit rate cost : weight is \$3.20 per pound and that the unit rate weight : cost is about 0.3 pound per dollar.